

CLAIMS

I/We claim:

- [c1] 1. A vehicle control system comprising:
a first control link operatively coupled between at least one control input device and at least one control output device, the first control link being configured to transmit control inputs for a vehicle between the at least one control input device and the at least one control output device during normal operation; and
a second control link, at least one portion of which is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state, the at least one portion being operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state.
- [c2] 2. The control system of claim 1, further comprising a detection system operatively coupled to the first control link to detect at least one failure in the first control link.
- [c3] 3. The control system of claim 1, further comprising:
a detection system operatively coupled to the first control link to detect at least one failure in the first control link; and
an engagement link operatively coupled to the detection system, the engagement link being configured to automatically couple the second control link between the at least one control input device and the at least one control output device to actively transmit control

inputs when the detection system detects the at least one failure in the first control link.

[c4] 4. The control system of claim 1 wherein the first control link includes an elongated flexible input transmission member configured to transmit control inputs between a first portion of the first control link and a second portion of the first control link, and wherein the control system further comprises a detection system operatively coupled to the first control link, the detection system being configured to detect a change of tension in the elongated flexible input transmission member.

[c5] 5. The control system of claim 1 wherein the first control link includes an elongated flexible input transmission member configured to transmit control inputs between a first portion of the first control link and a second portion of the first control link, and wherein the control system further comprises:

a detection system operatively coupled to the first control link, the detection system being configured to detect a tension in the elongated flexible input transmission member; and

an engagement link configured to automatically couple the second control link between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection system detects the tension in the elongated flexible input transmission member of the first control link has decreased below a threshold value.

[c6] 6. The control system of claim 1 wherein the first control link includes: an elongated flexible input transmission member configured to transmit control inputs between a first portion of the first control link and a second portion of the first control link; and

a coupler configured to operatively engage the elongated flexible input transmission member, and wherein the control system further comprises:
a detection system configured to detect a tension of the elongated flexible input transmission member; and
an engagement link configured to automatically couple the second control link between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection system detects the tension in the elongated flexible input transmission member of the first control link less than a threshold value.

[c7]

7. The control system of claim 1 wherein the first control link includes:
a cable member configured to transmit control inputs between a first portion of the first control link and a second portion of the first control link; and
a pulley system configured to operatively engage the cable member, the pulley system including two pulley portions pivotally coupled to each other, at least one of the pulley portions being movable relative to the other between a first position and a second position, the at least one portion being in the first position when the cable member is under a first amount of tension, the at least one portion being in the second position when the cable member is under a second amount of tension different than the first amount of tension, the second amount of tension being associated with at least one failure in the first control link, and wherein the control system further comprises:
a detection system configured to detect movement of the at least one pulley portion between the first and the second positions; and
an engagement link configured to automatically couple the second control link between the at least one control input device and the at least

one control output device to actively transmit control inputs when the at least one pulley portion is in the second position.

[c8] 8. The control system of claim 1 wherein at least a portion of the first control link includes a cable member having a diameter of less than 1/8 inch and being configured to transmit control inputs between a first portion of the first control link and a second portion of the first control link.

[c9] 9. The control system of claim 1 wherein at least a portion of the second control link includes a cable member having a diameter of less than 1/8 inch and being configured to transmit control inputs between a first portion of the second control link and a second portion of the second control link.

[c10] 10. The control system of claim 1, further comprising an actuation control coupled to the second control link and configured to allow an operator to selectively engage, disengage, or both engage and disengage the second control link to actively transmit control inputs between the at least one control input device and the at least one control output device.

[c11] 11. The control system of claim 1, further comprising:
 at least one detection system operatively coupled to at least one portion of
 the first and second control links; and
 an annunciation system operatively coupled to the at least one detection
 system configured to provide at least one indication of the status of
 the at least one portion.

[c12] 12 The control system of claim 1 wherein the second control link is configured to be engaged and transmit control inputs simultaneously with the first control link.

- [c13] 13. The control system of claim 1, further comprising:
a detection system operatively coupled to the first control link and configured to detect a motion limitation of at least one portion of the first control link; and
an engagement link configured to automatically couple the second control link between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection system detects the motion limitation.
- [c14] 14. The control system of claim 1, further comprising the vehicle, and wherein the vehicle includes an aircraft, the at least one control input device includes a pilot input control and the at least one control output device includes a flight control surface.
- [c15] 15. The control system of claim 1 wherein the at least one control input device includes a first control input device, and wherein the control system further comprises a second control input device coupled to the first control link.
- [c16] 16. A vehicle control system comprising:
a control link operatively coupled between at least one control input device and at least one control output device, the control link being configured to transmit control inputs between the at least one control input device and the at least one control output device, the control link including an elongated flexible input transmission member positioned to transmit control inputs between a first portion of the control link and a second portion of the control link while under tension; and
a detection system operatively coupled to the control link to detect a tension of the elongated flexible input transmission member.

[c17] 17. The system of claim 16 wherein the control link includes a first control link, and wherein the system further comprises:

a second control link, at least one portion of which is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state and being operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state; and

an engagement link operatively coupled to the detection system, the engagement link being configured to automatically couple the second control link between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection system detects a level of tension corresponding to a failure of the first control link.

[c18] 18. The system of claim 16 wherein the control link includes a first control link, the first control link includes a coupler configured to operatively engage the elongated flexible input transmission member, and the detection system is operatively associated with the coupler, and wherein the system further comprises:

a second control link, at least one portion of which is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state and being operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state; and

an engagement link operatively coupled to the detection system, the engagement link being configured to automatically couple the

second control link between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection system detects a level of tension corresponding to a failure of the first control link.

[c19]

19. The system of claim 16 wherein the control link includes a first control link and wherein the elongated flexible input transmission member includes a cable member and wherein the first control link further includes:

a pulley system configured to operatively engage the cable member, the pulley system including two pulley portions pivotally coupled to each other, at least one of the pulley portions being movable relative to the other between a first position and a second position, the at least one portion being in the first position when the cable member is under a first amount of tension, the at least one portion being in the second position when the cable member is under a second amount of tension different than the first amount of tension, the second amount of tension being associated with at least one failure in the first control link, the detection system being configured to detect movement of the at least one pulley portion between the first and the second positions, and wherein the control system further comprises:

a second control link, at least one portion of which is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state and being operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state; and

an engagement link operatively coupled to the detection system, the engagement link being configured to automatically couple the second control link between the at least one control input device and

the at least one control output device to actively transmit control inputs when the detection system detects movement of the at least one pulley portion between the first and the second positions.

[c20]

20. An aircraft flight control system comprising:
- an aircraft;
 - at least one pilot input control;
 - at least one flight control surface;
 - a first control link operatively coupled between the at least one pilot input control and the at least one flight control surface, the first control link being configured to transmit control inputs between the at least one pilot input control and the at least one flight control surface during normal operation, wherein the first control link includes a cable member configured to transmit control inputs between a first portion of the first control link and a second portion of the first control link;
 - a detection system operatively coupled to the cable member to detect a tension level in the cable member;
 - a second control link, at least one portion of which is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state and operatively coupled between the at least one pilot input control and the at least one flight control surface to transmit control inputs between the at least one pilot input control and the at least one flight control surface when in the engaged state; and
 - an engagement link configured to automatically couple the second control link between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection system detects a tension below a threshold tension level.

[c21] 21. The aircraft flight control system of claim 20 wherein the first control link includes:

a pulley system configured to operatively engage the cable member, the pulley system including two pulley portions pivotally coupled to each other, at least one of the pulley portions being movable relative to the other between a first position and a second position, the at least one portion being in the first position when the cable member is under a first amount of tension, the at least one portion being in the second position when the cable member is under a second amount of tension different than the first amount of tension, and wherein;

the detection system is configured to detect movement of the at least one pulley portion between the first and the second positions, and further wherein;

the engagement link is configured to automatically couple the second control link between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection system detects movement of the at least one pulley portion between the first and the second positions.

[c22] 22. A vehicle control system comprising:

first control link means for operatively coupling at least one control input device and at least one control output device, the first control link means being configured to transmit control inputs between the at least one control input device and the at least one control output device during normal operation; and

second control link means for operatively coupling the at least one control input device and the at least one control output device, at least one portion of the second control link means being changeable from an engaged state to a disengaged state, the at least one portion being configured to transmit control inputs between the at least one control

input device and the at least one control output device when in the engaged state, the at least one portion being inactive when in the disengaged state.

[c23] 23. The control system of claim 22, further comprising detection means for detecting at least one failure in the first control link means.

[c24] 24. The control system of claim 22, further comprising detection means for detecting an amount of tension in a portion of the first control link means, the amount of tension being associated with at least one failure of the first control link means.

[c25] 25. The control system of claim 22, further comprising:
detection means for detecting at least one failure in the first control link means; and
engagement link means for automatically coupling the second control link means between the at least one control input device and the at least one control output device to actively transmit control inputs when the detection means detects the at least one failure in the first control link means.

[c26] 26. The control system of claim 22 wherein the at least one control input device includes at least one pilot input control and the at least one control output device includes at least one flight control surface.

[c27] 27. An aircraft flight control system comprising:
control link means for actively transmitting control inputs between at least one control input device and at least one control output device during normal operation, the control link means including an elongated flexible input transmission member; and

detection means for detecting at least one failure in the control link means, the at least one failure associated with an amount of tension in the elongated flexible input transmission member.

[c28] 28. The system of claim 27 wherein the control link means includes first control link means, and the system further comprises:

second control link means for operatively coupling the at least one control input device and the at least one control output device, at least a portion of the second control link means being changeable from an engaged state to a disengaged state, the at least one portion being configured to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state, the at least one portion being inactive when in the disengaged state; and

engagement means for automatically engaging the second control link means to actively transmit control inputs between the at least one control input device and the at least one control output device when the detection means detects a tension in the cable member below a threshold value.

[c29] 29. The system of claim 27 wherein the control link means includes first control link means and further includes:

coupler means operatively coupled to the elongated flexible input transmission member, the coupler means having a first state and a second state, the first state associated with a first amount of tension in the elongated flexible input transmission member and the second state associated with a second amount of tension in the elongated flexible input transmission member, the second amount of tension associated with the at least one failure in the first control link; and

detection means configured to detect a transition between the first state and the second state, and wherein the system further comprises:
second control link means for operatively coupling the at least one control input device and the at least one control output device, at least a portion of the second control link means being changeable from an engaged state to a disengaged state, the at least one portion being configured to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state, the at least one portion being inactive when in the disengaged state; and
engagement means for automatically engaging the second control link means to actively transmit control inputs between the at least one control input device and the at least one control output device when the detection means detects the transition between the first state and the second state.

[c30] 30. A method for manufacturing an aircraft flight control system comprising:

coupling a first control link between at least one control input device and at least one control output device, the first control link being configured to transmit control inputs between the at least one control input device and the at least one control output device during normal operation; and
coupling a second control link between the at least one control input device and the at least one control output device, with at least one portion of the second control link being changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state, the at least one portion being operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs between

the at least one control input device and the at least one control output device when in the engaged state.

[c31] 31. The method of claim 30 wherein the first control link includes an elongated flexible input transmission member, and wherein the method further comprises:

coupling a detection system to the first control link, the detection system being positioned to detect at least one failure of the first control link associated with an amount of tension in the elongated flexible input transmission member; and

connecting an engagement link between the first and second control links, the engagement link being positioned to automatically engage the second control link to transmit control inputs between the at least one control input device and the at least one control output device when the detection system detects a tension in the elongated flexible input transmission member below a threshold value.

[c32] 32. The method of claim 30 wherein the first control link includes an elongated flexible input transmission member, and wherein the method further comprises:

coupling a detection system to the first control link, the detection system being positioned to detect at least one failure of the first control link associated with an amount of tension in the elongated flexible input transmission member;

connecting an annunciation system to the detection system to indicate the at least one failure to an operator; and

connecting an actuation control to the second control link, the actuation control being positioned to allow the operator to engage the second control link.

[c33] 33. A method for manufacturing an aircraft flight control system, comprising:

coupling a control link between at least one control input device of an aircraft and at least one control output device of the aircraft, the control link including an elongated flexible input transmission member coupling a first portion of the control link to a second portion of the control link; and

operatively coupling a detection system to the elongated flexible input transmission member to detect at least one failure in the control link, with the at least one failure being associated with an amount of tension in the elongated flexible input transmission member less than a threshold value.

[c34] 34. The method of claim 33, further comprising:
coupling the elongated flexible input transmission member to the first portion of the control link with a coupler; and
connecting the detection system to the coupler to detect a change in state of the coupler caused by a change in tension in the elongated flexible input transmission member.

[c35] 35. The method of claim 33 wherein the control link includes a first control link, and wherein the method further comprises:

operatively coupling a second control link between the at least one control input device and the at least one control output device, the second control link having at least one portion that is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state, the at least one portion being operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs

between the at least one control input device and the at least one control output device when in the engaged state; and
connecting an engagement link between the first and second control links and to the detection system, the engagement link being positioned to automatically engage the second control link to transmit control inputs between the at least one control input device and the at least one control output device when the detection system detects the amount of tension in the elongated flexible input transmission member below a threshold value.

[c36] 36. A method for controlling a control output device of an aircraft flight control system comprising:

transmitting a control input between at least one control input device and at least one control output device via a first control link during normal operation without transmitting the control input to the at least one control output device via a second control link, at least a portion of the second control link between the at least one control input device and the at least one control output device being disengaged; and
engaging the second control link to actively transmit control inputs between the at least one control input device and the at least one control output device.

[c37] 37. The method of claim 36 wherein the first control link includes an elongated flexible input transmission member, and wherein the method further comprises:

detecting at least one failure in the first control link, the at least one failure being associated with an amount of tension in the elongated flexible input transmission member;
indicating the at least one failure to an operator; and

engaging the second control link based on input received from the operator.

[c38] 38. The method of claim 36 wherein the first control link includes an elongated flexible input transmission member, and wherein the method further comprises:

detecting at least one failure in the first control link, the at least one failure associated with the amount of tension in the elongated flexible input transmission member; and
automatically engaging the second control link.

[c39] 39. A method for detecting a failure in an aircraft flight control system comprising:

detecting a level of tension in an elongated flexible input transmission member configured to transmit control inputs between a first portion of a control link and a second portion of the control link, the control link being configured to transmit at least one control input from at least one control input device to at least one control output device; and
transmitting a signal corresponding to the level of tension.

[c40] 40. The method of claim 39 wherein at least one level of tension is associated with at least one failure in the control link.

[c41] 41. The method of claim 39 wherein the elongated flexible input transmission member is operatively coupled to the first portion of the control link with a coupler, and wherein the method further comprises detecting a change in state of the coupler caused by a change in the level of tension in the elongated flexible input transmission member.

[c42] 42. The method of claim 39 wherein the control link includes a first control link, and wherein the method further comprises engaging a second control link, at least one portion of which is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state, the at least one portion operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state.

[c43] 43. The method of claim 39 wherein the control link includes a first control link, and wherein the method further comprises:
indicating the at least one failure to an operator; and
engaging a second control link, at least one portion of which is changeable from a disengaged state to an engaged state, the at least one portion being inactive when in the disengaged state, the at least one portion operatively coupled between the at least one control input device and the at least one control output device to transmit control inputs between the at least one control input device and the at least one control output device when in the engaged state.